Tanta University

Faculty of Engineering

Electrical Power and Machines
Engineering Department

Electric Circuit (1) Lab Experiments

1st Year of Electrical Engineering
1st Term

Theory is when You know every thing but nothing work.

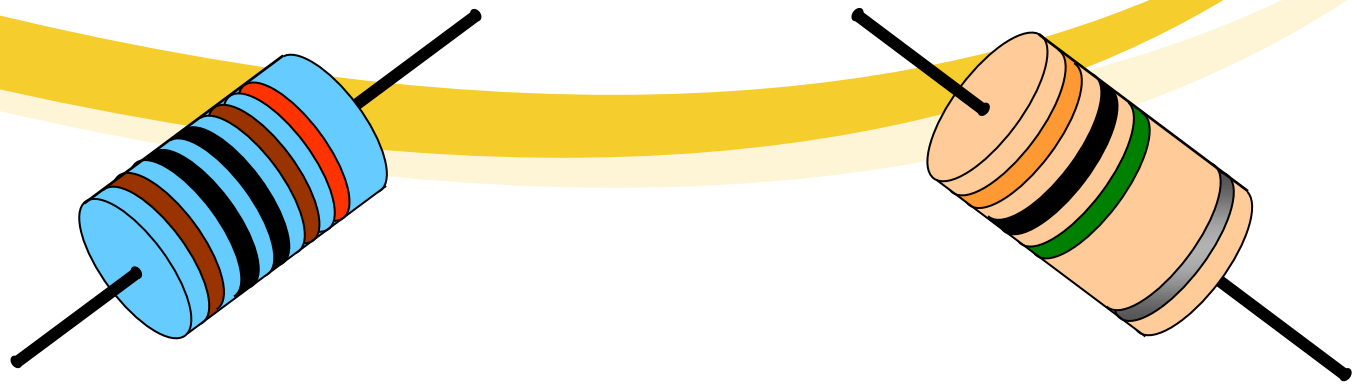
Practical is when every thing works but no one know why.

In our Lap, theory and practical are combined:

relatively, You know every thing and every thing works, ISA.

Experiment (1)

Understanding the Resistor Color Code



Resistor Color Code

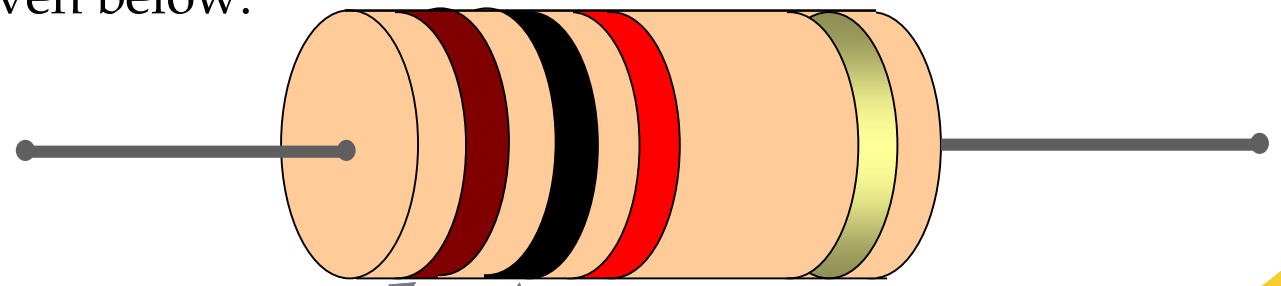
- Manufacturers typically use a color band system known as the resistor color code.
- In this experiment, you will learn how to identify the **nominal resistance** and the **tolerance** of a resistor.

Resistor Color Code

- The power rating is *not* indicated in the resistor color code and must be determined by experience using the physical size of the resistor as a guide.
- For resistors with ±5% or ±10% tolerance, the color code consists of 4 color bands.
- For resistors with ±1% or ±2% tolerance, the color code consists of 5 color bands.

4-Band Resistors

The resistor nominal value is encoded in the color code in Powers of Ten Notation. The template for determining the nominal value and tolerance of a resistor with 4 color bands is given below:



1st Band = 1st Significant Digit

2nd Band = 2nd Significant Digit

3rd Band = Multiplier

4th Band = Tolerance

$$\_\_\_\ \_\_\_ \times 10^{\_\_\_}\ \Omega \pm \_\_\_\_\ \%$$

How do we know which color corresponds to which number?

Using the Resistor Color Code Table

Color	Digit	Multiplier	Tolerance
Black	0	$10^0 = 1$	
Brown	1	$10^1 = 10$	±1%
Red	2	$10^2 = 100$	±2%
Orange	3	$10^3 = 1{,}000$	
Yellow	4	$10^4 = 10{,}000$	
Green	5	$10^5 = 100{,}000$	
Blue	6	$10^6 = 1{,}000{,}000$	
Violet	7	$10^7 = 10{,}000{,}000$	
Gray	8	$10^8 = 100{,}000{,}000$	
White	9	$10^9 = 1{,}000{,}000{,}000$	
Silver		$10^{-2} = 0.01$	±10%
Gold		$10^{-1} = 0.1$	±5%
No band	---	---------	±20%

Minimum and Maximum Values of Resistance

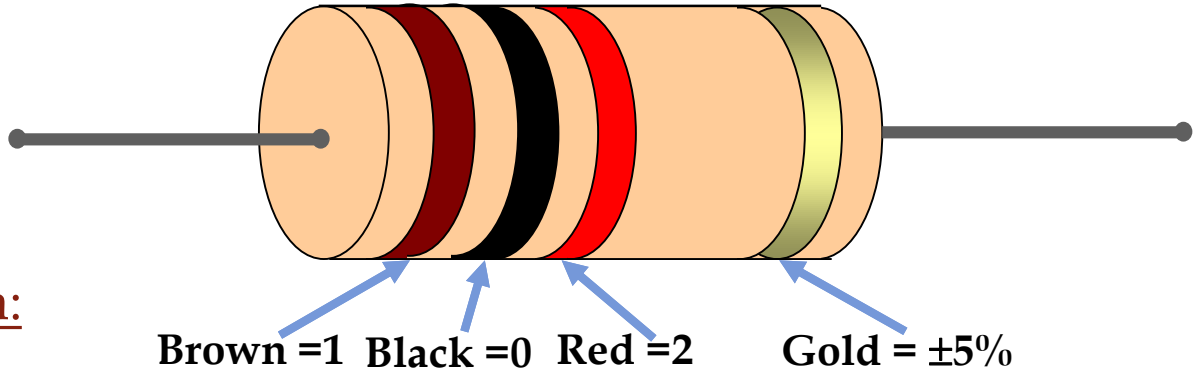
- The Minimum value can be determined by multiplying the nominal value to the tolerance value then subtracted from the nominal value.

  Min.value=nom.value - nom.value*tolerance

- The Maximum value can be determined by multiplying the nominal value to the tolerance value then added it to the nominal value.

  Max.value=nom.value + nom.value*tolerance

Example (1): Determine the nominal resistance value and the tolerance for the resistor shown below.



Solution:

$$\underline{1}\ \underline{0} \times 10^{\underline{2}}\ \Omega \pm \underline{5}\ \%$$

Nominal value $= 10 \times 10^2 \Omega$

$= 1{,}000\Omega$

Tolerance = ±5%.

Converting between units

It is typical to express the resistance value in:

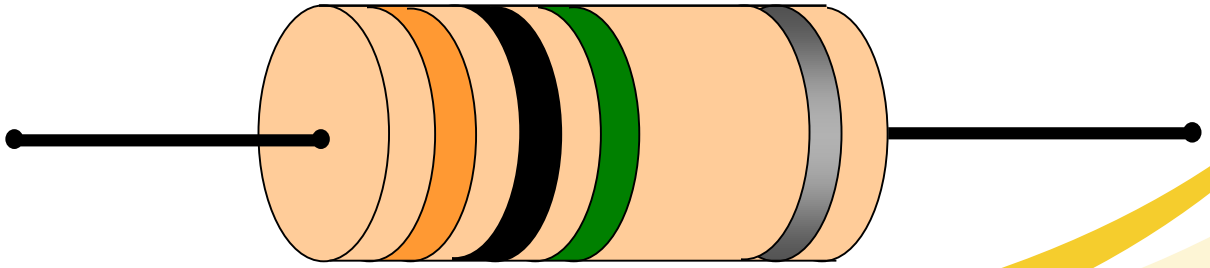
- kΩ if the resistance ≥ 1,000Ω.
- MΩ if the resistance ≥ 1,000,000Ω.

❖ To convert from Ω to kΩ, Ω to MΩ, or vice-versa, use the table below:

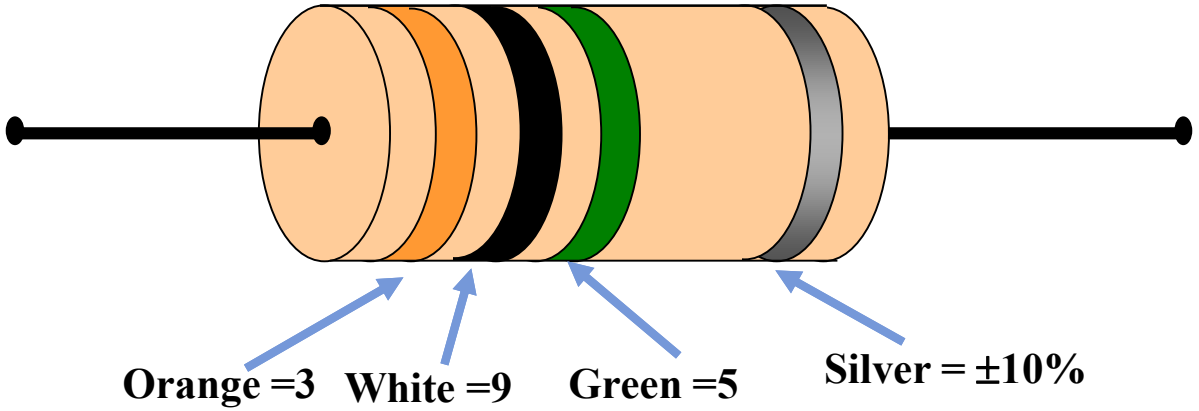
Table 2. Ω, kΩ, MΩ Conversion Table		
To Convert From	**To**	**Action**
Ω	kΩ	Divide by 1,000
Ω	MΩ	Divide by 1,000,000
kΩ	Ω	Multiply by 1,000
MΩ	Ω	Multiply by 1,000,000

Exercise (1)

a) Determine the nominal value and tolerance for the resistor below.
b) What is the min. resistance value this resistor can actually have.
c) What is the max. resistance value this resistor can actually have.



Solution



$$\underline{3}\ \underline{9} \times 10^{\underline{5}}\ \Omega \pm \underline{10}\ \%$$

Resistor nominal value = $39 \times 10^5 \Omega$

= $3{,}900{,}000 \Omega$

= $3.9 M\Omega$.

Tolerance = ±10%

Solution: continued

Minimum resistance value:

nominal value - nominal value * tolerance:

$$= 3.9M\Omega - 3.9M\Omega * 0.1$$
$$= 3.9M\Omega - 0.39M\Omega$$
$$= 3.51M\Omega$$

Maximum resistance value:

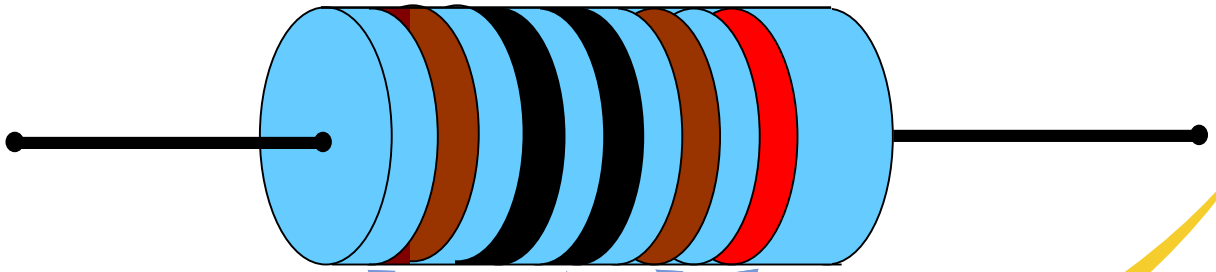
nominal value + nominal value * tolerance:

$$= 3.9M\Omega + 3.9M\Omega * 0.1$$
$$= 3.9M\Omega + 0.39M\Omega$$
$$= 4.29M\Omega$$

5-Band Resistors

For resistors with ±1% or ±2% tolerance, the color code consists of 5 bands.

The template for 5-band resistors is:



1st Band = 1st Significant Digit

2nd Band = 2nd Significant Digit

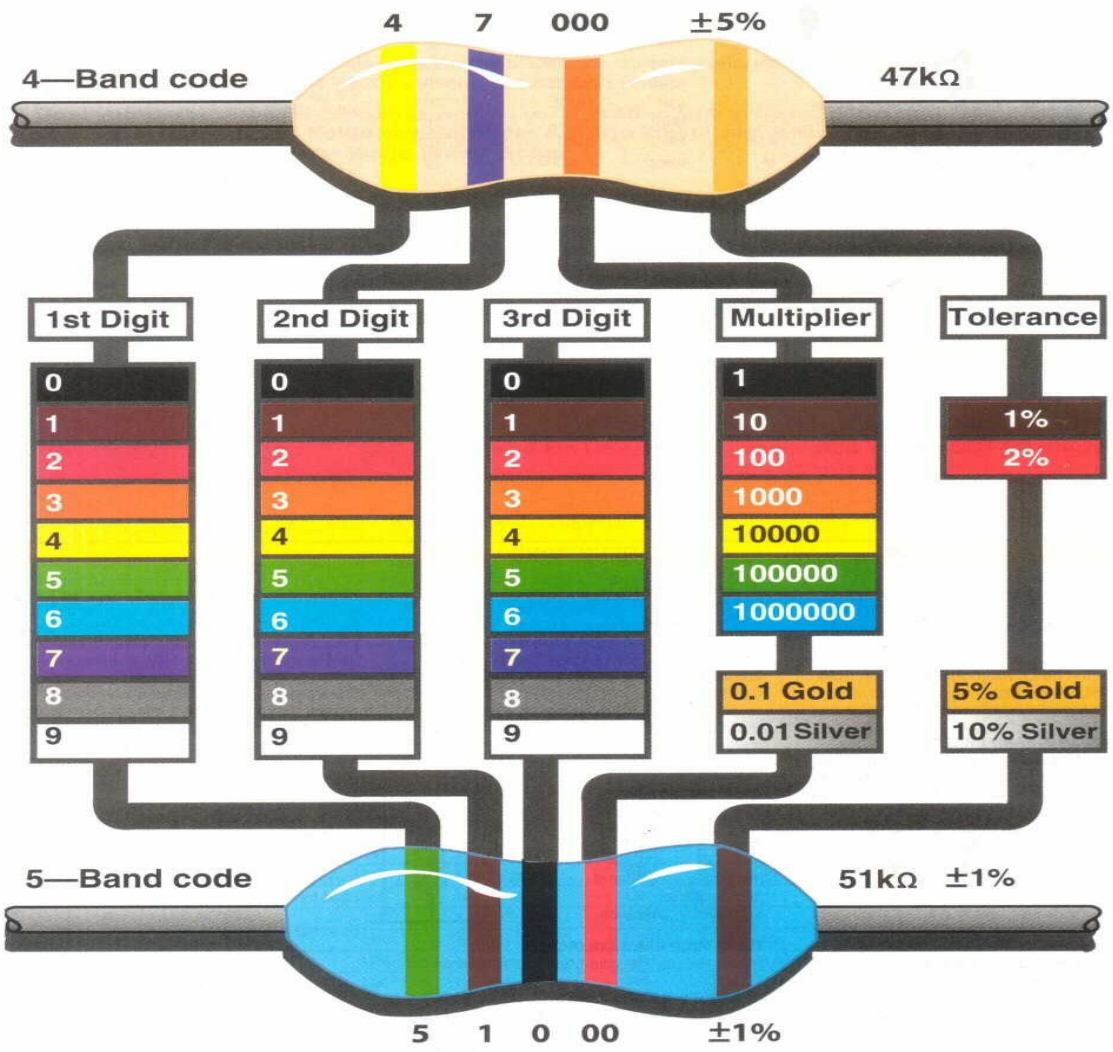
3rd Band = 3rd Significant Digit

4th Band = Multiplier

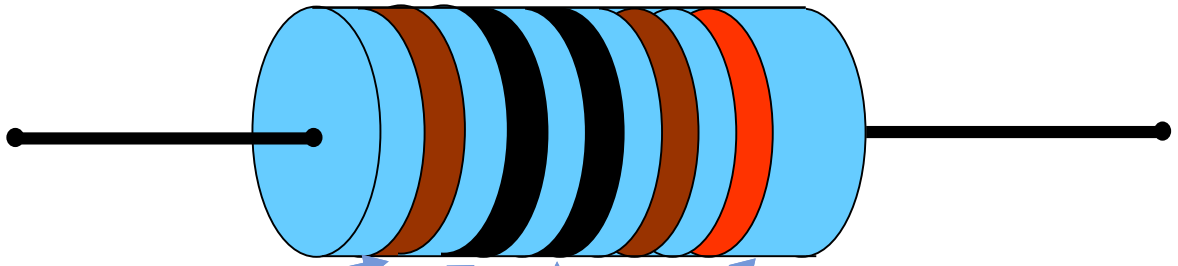
5th Band = Tolerance

___ ___ ___ × 10 ___ Ω ± ____ %

RESISTOR COLOUR CODE



Example (2) Determine the nominal resistance and tolerance for the resistor shown below.



Solution:

Brown = 1 Black =0 Black = 0 Brown = 1 Red = ± 2%

1 0 0 × 10 ^{1} Ω ± 2 %

Resistor nominal value = $100 \times 10^{1}\Omega$

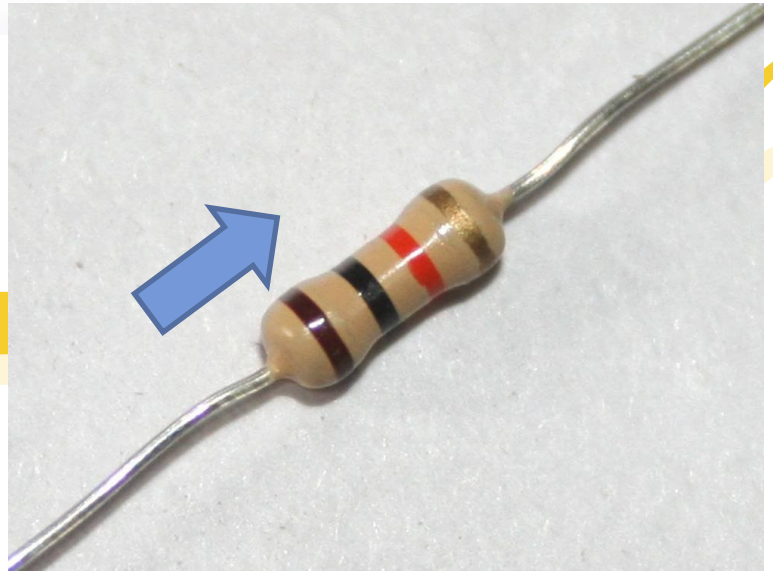
= 1,000Ω

= 1kΩ.

Tolerance = ±2%

Which side of a resistor do I read from?

For 4-band resistors a **gold** or **silver** band is always the **last band** (Tolerance Band)



Measuring Resistance using AVO-meter

THANKS